Introduction to the CSC Electronics

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The ATLAS Cathode Strip Chambers (CSCs) have 4 gas gaps, with anode wires running radially and precision cathode strips in the r-ϕ direction. Cathode strip pitch is 5 mm. Two "wheels" of 32 chambers each are located in the ATLAS endcap region (Figure 1).

In response to the ionization produced by a charged particle track the CSCs generate charge on a cluster of 3-5 strips. A charge deposit of about 80 fC ($5 \cdot 10^5$ electrons) per strip (most-probable Landau) is expected at the designed chamber gain and shaping time. In any given layer there may be a drift time of up to 30 ns.

The CSC electronics must be able to record the charge on the strips in a cluster accurately enough to allow interpolation to 1/100 of the strip pitch. In addition, it must buffer the analog data for the L1 trigger latency, and reject tracks which are not in time with the triggered beam crossing. The off-detector electronics may optionally be configured to identify and reject single-layer hits and tracks which do not project back to the I.P.

A block diagram of the CSC electronics chain is shown in Figure 2. Signals from the chamber are first processed by detector-mounted circuitry ("on-detector electronics"), then sent over fiber optic links to crate-mounted off-detector electronics. The on-detector electronics consists of ASM-I and ASM-II boards mounted inside Faraday shields with integral cooling plates along the narrow edge of each CSC, as shown in Figure 3 and Figure 4.

ASM-I boards interface directly to the CSC and contain custom CMOS preamplifier/shaper ASICs for charge amplification. Each ASM-I services 96 strips, 48 from each of two non-adjacent planes. Signals from two ASM-I's are routed through a transition board to the ASM-II which contains a modified version of the ATLAS Liquid Argon calorimeter sampling readout. The ASM-II performs analog buffering, digitization, and serialization of the data from the strips in response to a trigger. The ASM-II thus handles signals from 192 channels. It uses 16 twelve-channel SCA's (DMILL rad-tolerant CMOS process), 16 twelve-bit ADCs, a digital multiplexer, and two gigbit serializer/transmitters. The combined assembly of two ASM-I's, transition board, and ASM-II is labeled "ASM-PACK". All control signals for an ASM-PACK are generated by the off-detector electronics and transmitted by fiber optic link. There is one control link (toward detector) and two data links (toward counting room) per ASM-PACK.

Four ASM-II boards process the signals from all the precision strips in the CSC. In addition, there are 48 y-strips per layer which provide coarse transverse coordinate readout.These strips are served by a fifth ASM-PACK. All together, the system summary is

SYSTEM
- 2 endcaps
- 64 chambers
- 61,440 channels
- 640 ASM-PACKs
- 32 Sparsifier/RODs

CHAMBER
- 4 layers
- 960 channels (768 precision, 192 transverse)
- 5 ASM-PACKs
- 15 optical links (10 data, 5 control)

ASM-PACK
- 192 channels

- 1 ASM-II board
- 2 ASM-I boards
- 3 fiber optic links

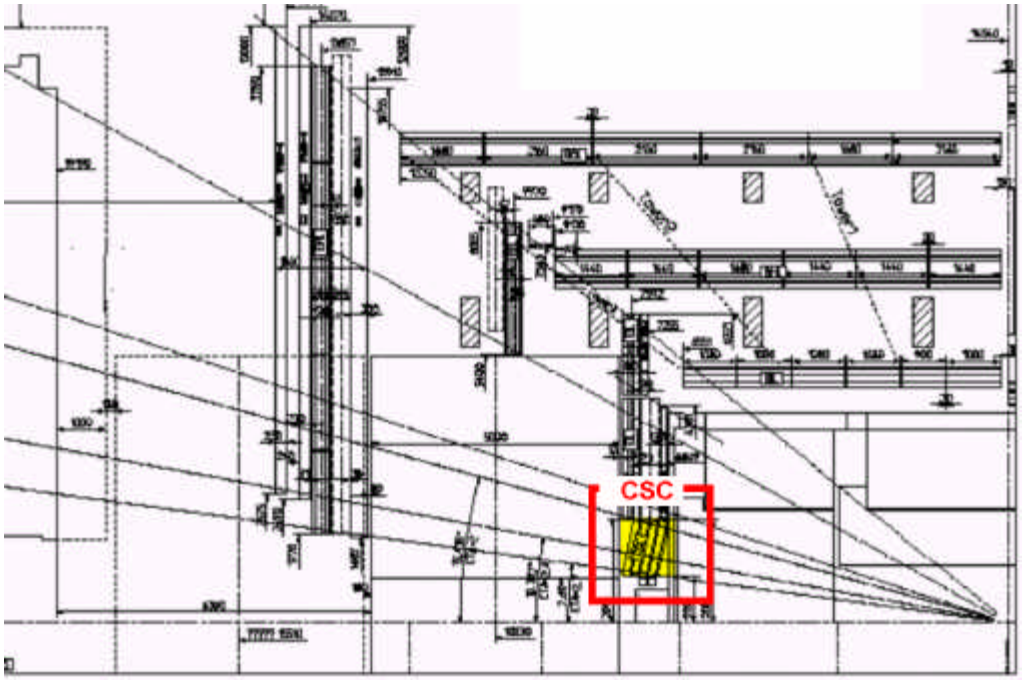
ASM-II

- 192 channels
- 2 ASM-I's
- 16 SCA ASICs
- 16 ADCs
- 2 serializer/transmitters
- 1 receiver/deserializer

ASM-I

96 channels
16 Preamp/Shaper ASICs

Figure 1 CSC Location in ATLAS; CSC endcap



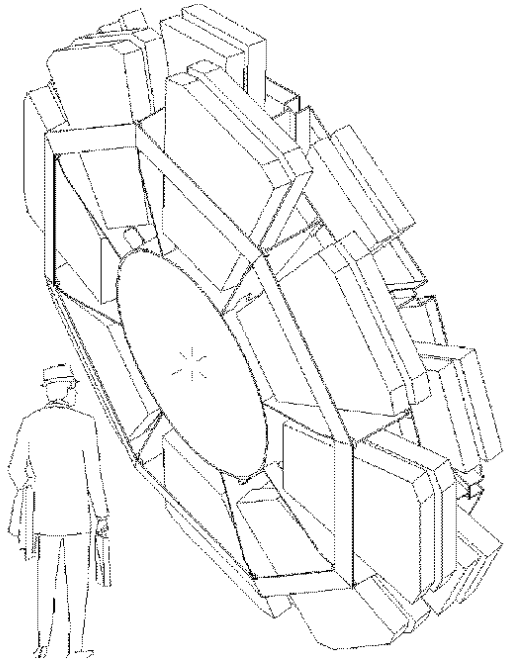


Figure 2 Signal Flow in the CSC Electronics Chain

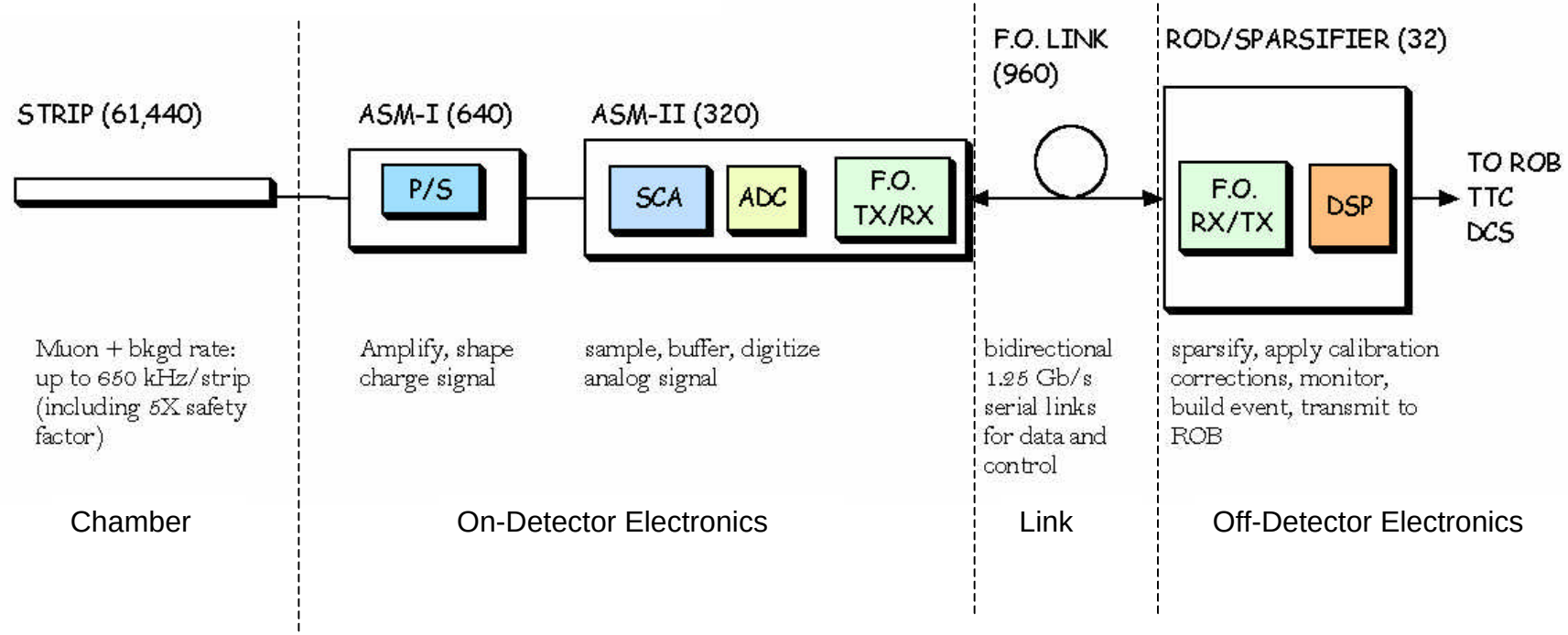
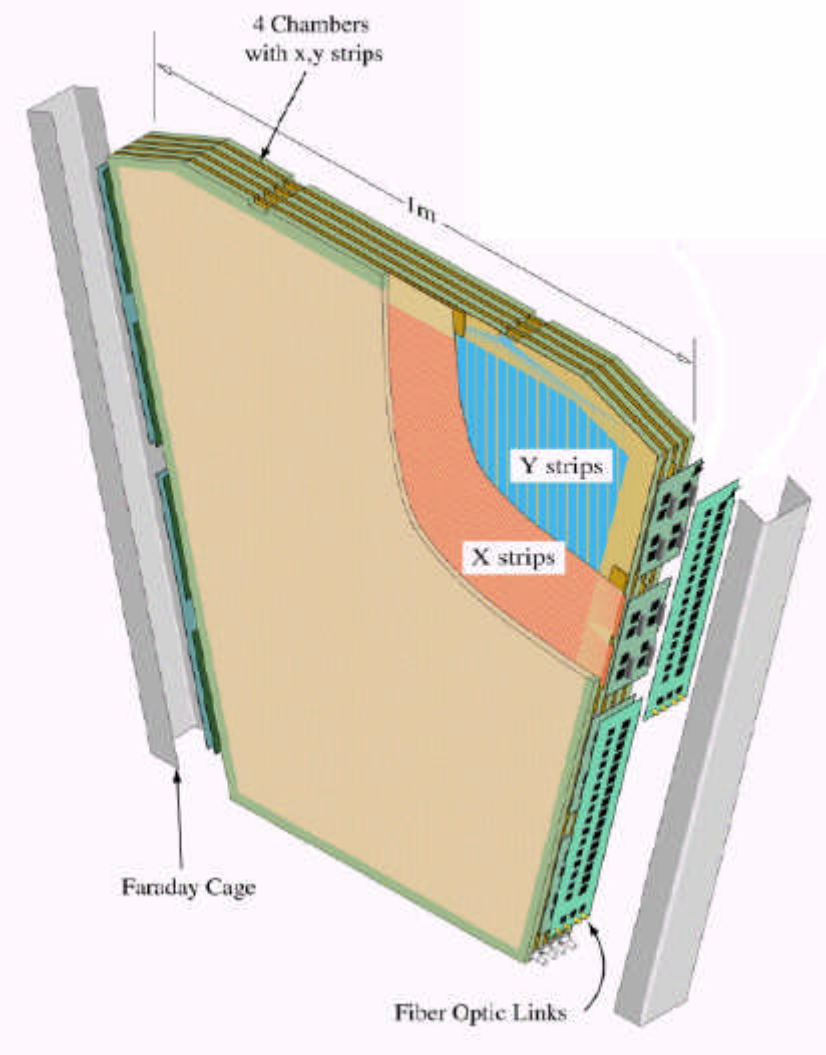


Figure 3 CSC Electronics Location on Chambers



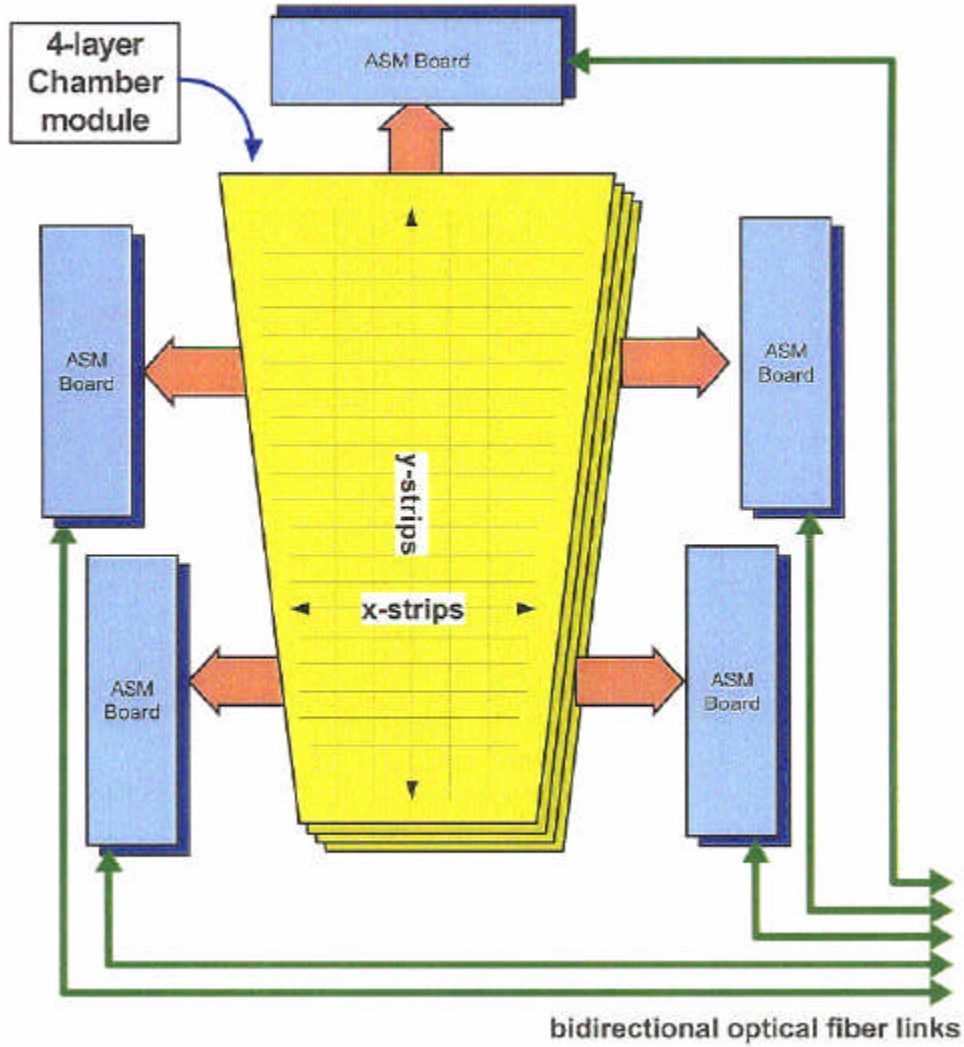


Figure 4 On-Detector Electronics Mounting